AMENDMENTS TO THE SPECIFICATION:

Please replace paragraph [0004] with the following amended paragraph:

[0004] The present invention relates generally to ~~apparatus and~~ a method for enhancing safety, reducing failures of systems that carry exclusively or as mixtures electrical, optical, electromagnetic signals, fluids, gases or solids by determining and locating the identity of stress factors (stressors) that cause deterioration and damage affecting the health, status and integrity of conduits and conductive paths, as well as components thereof including cladding, insulating materials, conductors and the signals or media they transport. More particularly it relates to an apparatus with a combination of active and passive components used in-situ for automated inspection periodically or in real time, or during periodic inspection with visual, instruments or automated means to pro-actively identify, measure, diagnose and prognose damage and deterioration as well as the causes thereof.

Please replace paragraph [0014] with the following amended paragraph:

[0014] Currently nothing is in wide use that combines detection of stressors, detection and diagnosis of damage to a conduit in progress, and prognosis of risk of conduit failure and system failure. The disclosure of U.S. Pat. No. 4,988,949 by Boenning et al is limited to detecting mechanical damage (chafing) on electrical cables against grounded structures under constant monitoring. ~~U.S. Patent No. 4,988,949 by Boenning et al teaches detecting mechanical damage (chafing) on electrical cables (by sensing electrical erosion of a semiconductive material) against grounded structures under constant monitoring. Boenning's patent does not teach a means to perform detection and location of damage without need for end-to-end test a semiconductor detector circuit. The present invention overcomes limitations of the said Boenning patent by using light parameter measurement and does so without the need for end-to-end measurement. The present invention eliminates the need for electrical sensing which can be a safety concern, and in the preferred embodiment eliminates end-to-end tests thereby reducing cost and weight and potentially reducing the time for installation.~~ The disclosure of U.S. Pat. No. 6,265,880 by Born et al discloses use of a length of electrical conducting media (such as a wire) along the outside of a conduit to detect mechanical damage (chafing), and improves on said Boenning's patent by teaching periodic testing, and detecting chafing on conduits other than electrical cables, and detecting chafing against a non-electrically grounded structure.

Please replace paragraph [0015] with the following amended paragraph:

[0015] Watkins patent U.S. Pat. No. 5,862,030 teaches an electrical safety device comprised of a sensor strip disposed in the insulation of a wire or in the insulation of a sheath enclosing a bundle of electrical conductors, where the sensor strip comprises a distributed conductive over-temperature sensing portion comprising an electrically conductive polymer having a positive temperature coefficient of resistivity which increases with temperature sufficient to result in a switching temperature. Said Watkins' patent also teaches use of electricity with a mechanical damage (chafing) sensing portion comprised of a strip disposed in the sheath in a mechanical damage sensing pattern which like said Born's patent becomes damaged or open upon mechanical damage of the sheath before the bundle of conductors are damaged. Watkins' patent does not teach a means to perform detection of mechanical damage without use of an electrically conductive sensor material. ~~The present invention overcomes limitations of use of electrical signals by both Watkins' patent and Born's U.S. Pat. No. 6,265,880 by teaching use of measuring change in sensor parameters without the need for end-to-end electrical connectivity. Removing the use of electrical circuits along the conduit is important because electrified polymers or wires can be a safety concern, especially in fire or explosion prone situations that could be caused by electrical signals.~~

Please replace paragraph [0017] with the following amended paragraph:

[0017] Thus there exists a need for ~~an apparatus~~ a means to detect and identify multiple types of stressors, to quickly measure and interpret multiple types of damage including but not limited to mechanical damage (chafing), all prior to any damage to the internal structure of a conduit or to systems in the vicinity of the conduit. Further there exists a need for a method to combine and fuse information of type and amount of damage with identity of stressors and rate of damage to estimate in a timely fashion the risks of future damage. Further there exists a need for a means to mark multiple points of damage to aid in repair and remediation.

Please delete the previously added paragraphs between paragraphs [0020] and [0021].

Please add the following new paragraph before paragraph [0021]:

[0020.1] The current invention is a method for determining the health status of conduit components, conduit sections, and systems that utilize conduits. Briefly stated, the method is comprised of the steps of: determining the requirements for monitoring the system of conduits; defining the functions of the

distributed computers, diagnostic and prognostic software to meet the requirements; selecting the parameters to be sensed and monitored; selecting the components consisting of electronics, hardware, software, firmware and set of discrete sensors and strips of sensitized medium to implement the functions; designing and manufacturing the form and fit of the monitoring device comprised of said components; applying, placing, attaching or embedding the monitoring apparatus in a conduit; and placing the discrete sensors and strands of sensitized medium along the length of said conduit. The purpose of the discrete sensors is to measure characteristic parameters of the conduits and stress causing factors. The said strands of sensitized medium, each having a first end and a second end, being placed such that damage inducing factors such as an a solid object, gas, liquid, powder or electromagnetic waves contacts said medium prior to contacting said conduit. The combination of discrete sensors and strands of sensitized medium provide a means for determining by a combination of measurement and deductive algorithms whether, when and where and to what extent said damage inducing factors have damaged each of said multiplicity of sensitized medium. Algorithms of a monitoring application use the said determinations along with other a-priori data to infer damage or pending damage to conduit components, conduit sections, and systems of conduits.

Please replace paragraph [0024] with the following amended paragraph:

[0024] Another object is to provide a means to ~~mark~~ locate places where damage has occurred and coincidentally ~~mark~~ locate a place on the stressor as well.

Please replace paragraph [0029] with the following amended paragraph:

[0029] (a) to provide ~~a mechanism and~~ a means for unattended surveillance and real time inspection of conduits;

Please replace paragraph [0030] with the following amended paragraph:

[0030] (b) to ~~mark~~ provide a method to identify the probable cause of and estimate the location the points of damage so as to facilitate remedial action;

Please replace paragraph [0033] with the following amended paragraph:

[0033] There is an important and significant advantage in using data from measurements of characteristic parameters of strands of sensitized medium, and in particular strands that detect damage without the use of electrical excitation or interrogation. Individually, the purpose of the sensitized strands constructed in the manner of the present invention detect and provide data on damage and condition s that could lead to damage, such as ingress of fluids.

Please delete paragraph [0034].

Please delete paragraphs [0036] and [0037].

Please replace paragraph [0038] with the following amended paragraph:

[0038] It is an advantage that the present invention can be ~~constructed~~ implemented with an integral microcontroller for real time in-situ sensitized medium and sensor management, data processing, and communications.

Please delete paragraph [0039].

Please delete paragraph [0041].

Please replace paragraph [0046] with the following amended paragraph:

[0046] Briefly stated, the present invention is a ~~system that provides a mechanism and~~ method to detect multiple forms of damage to a conduit and perform diagnosis, prognosis related to condition and remaining useful life of said conduit, thereby reducing the chance of failure of any system that would be damaged or whose function would be impaired by damage to the conduit. Such a system could carry electrical power, optical or electromechanical signals, fuel or other fluids, may be hydraulic or pneumatic, or may carry solids such as particles.

Please delete previously added paragraphs after paragraph [0046] beginning "The amount of luminosity and intensity..." and "Measurements of optical parameters include taking readings..."

Please replace paragraph [0047] with the following amended paragraph:

[0047] The present invention is ~~comprised of a monitoring device~~ a method that is constructed with ~~at least one~~ a microcontroller ~~and at least one signal generator~~ or other computer connected optically or electrically or mechanically to a combination of a set of discrete sensors and a multiplicity of strands of sensitized media placed on, into, or woven as a sheath substantially surrounding, a conduit and that when attached to, sleeved over, or embedded into said conduit provides a means whereby to collect data to detect, locate, and reason the existence, cause and degree of stress or damage to the sensitized medium themselves and by programs and algorithms in the microcontroller or other computer to sense, detect, locate and reason risk of damage of the conduit ~~to which the sheath is attached thereby reducing the chance of failure of any system which would be damaged or whose function would be impaired or degraded by damage to the conduit~~.

Please replace paragraph [0052] with the following amended paragraph:

[0052] The novel aspects of this invention are set forth with particularity in the appended claims. The invention itself, together with further objects and advantages thereof may be more readily comprehended by reference to the following detailed description of presently preferred embodiments of the invention, taken in conjunction with the accompanying drawings, in which: ~~according to the teaching of this patent, a single-ended optical measurement of will detect a decrease of flux or a increase of flux due to the amount of foreshortening of the strand by a cut through or break; or because of ingress of rays of light into the affected when the interior of the sensitized strand is exposed but the strand is not foreshortened.~~

Please replace paragraph [0053] with the following amended paragraph:

[0053] FIG. 1 is diagrammatic view of the technique of the invention and shows how damage to one or more strands of sensitized media~~, each coated with an optically opaque substance,~~ employed according to the invention provide the basis not only for accurately locating the place of damage but also provides evidence for reasoning the probable cause of damage. This can be extended by selecting sensitized media constructed in accordance with the invention that are individually or severally affected by stressors. In practice the sensitized media will be individually selected based on the specific application and operation environment of the conduit.

Please add the following new paragraph after paragraph [0066]:

[0066.1] FIG. 7, FIG. 8, FIG. 9, FIG. 10, FIG. 11, FIG. 12, and FIG. 13 are a set of flow diagrams that explain the method of my patent. A person familiar with the construction of flow diagrams would know and understand that each symbol in any flowchart is a brief description of more complex underlying procedures which could encompass thousands of procedures to satisfy a certain intent. Because space available does not permit a single drawing, flow diagrams branch and are more fully described in the other diagrams. A person familiar with the construction of flow diagrams would know and understand that the arrangement of process steps indicated by the symbols can sometimes be relabeled, added, deleted, rearranged, or combined, or otherwise modified to show the level of detail desired.

Please number the previously added paragraphs of Reference Numerals [20] though [24] as following:

[0085.1] [20] strand with core doped with florescent chemical and plated with base metal
[0085.2] [21] strand, with core doped with florescent chemical and plated with noble metal
[0085.3] [22] strand of solid glass
[0085.4] [23] marker strand
[0085.5] [24] spool

Please add after paragraph [0085.5] the following list of Reference Numerals used in the newly added figures:

[0085.6] [25] the monitoring applications
[0085.7] [26] data from first tests
[0085.8] [27] baseline characteristics
[0085.9] [28] set of causal models
[0085.10] [29] set of analysis algorithms
[0085.11] [30] set of control algorithms
[0085.12] [31] data from monitoring
[0085.13] [32] determine requirements
[0085.14] [33] define the diagnostic and prognostic functions
[0085.15] [34] select the characteristics to be sensed and monitored
[0085.16] [35] define the appropriate architecture
[0085.17] [36] select a set of discrete sensors and sensitized medium

[0085.18] [37] construct the monitoring devices

[0085.19] [38] develop models

[0085.20] [39] develop the monitoring applications

[0085.21] [40] install the apparatus

[0085.22] [41] perform first test sequence

[0085.23] [42] monitoring

[0085.24] [43] diagnose health states

[0085.25] [44] prognosis

[0085.26] [45] communicating data and knowledge

[0085.27] [46] machine learning

[0085.28] [47] improving models

[0085.29] [48] conduct first test sequence of sensors and sensitized strands

[0085.30] [49] conduct first test sequence of the system of conduits

[0085.31] [50] develop the algorithms

[0085.32] [51] develop control software

[0085.33] [52] integration and testing

[0085.34] [53] initialize for tests

[0085.35] [54] increment the discrete sensor counter

[0085.36] [55] measure discrete sensor data

[0085.37] [56] determine sensor change

[0085.38] [57] choose to repeat sensor test

[0085.39] [58] if last discrete sensor

[0085.40] [59] fuse set of discrete sensor data tuples

[0085.41] [60] increment the strand counter

[0085.42] [61] measure sensitized strand data

[0085.43] [62] determine strand change

[0085.44] [63] choose to repeat strand test

[0085.45] [64] if last strand

[0085.46] [65] fuse set of strand data tuples

[0085.47] [66] record sets of sensor and strand data tuples

[0085.48] [67] generate weighting parameters

[0085.49] [68] data fusion

[0085.50] [69] diagnose health states of sensors and strands

[0085.51] [70] diagnose health states of conduit components

[0085.52] [71] diagnose health states of conduit sections

[0085.53] [72] diagnose health states of system of conduits

[0085.54] [73] decide to locate damage

[0085.55] [74] locate damage

[0085.56] [75] predict damage states

[0085.57] [76] predict effects

[0085.58] [77] predict health states

[0085.59] [78] predict remedial actions

[0085.60] [79] perform inference

[0085.61] [80] compute causal relationships

[0085.62] [81] update causal models

[0085.63] [82] compute new parameter statistics

[0085.64] [83] update model parameters

[0085.65] [84] update the monitoring applications

[0085.66] [85] record data

[0085.67] [86] select a-priori information

[0085.68] [87] process new characteristic information

[0085.69] [88] determine any change from prior characteristics

[0085.70] [89] record characteristics

[0085.71] [90] choose to measure location

[0085.72] [91] measure the location of the change

[0085.73] [92] estimate degree of damage

[0085.74] [93] record health state information

Please replace paragraph [0086] with the following amended paragraph:

[0086] In order to achieve the objectives of the above mentioned, the present invention ~~provides as system made up of a method and an apparatus, the apparatus comprising:~~ is a method for monitoring a system of conduits for the purpose of determining health states that works by processes that are the means to obtain, baseline and learn from data; the means to learn and fuse data to probabilistically assess causal factors of damage; the means to quantify the state of deterioration and damage that has occurred; the means to assess the risk that a situation exists that likely will soon cause deterioration or damage to happen; and the means to formulate and communicate messages about the health state, deterioration, damage, risks of damage and causal factors.

Please replace paragraph [0087] with the following amended paragraph:

[0087] The current method algorithmically processes data including stressor data and data from a set of discrete sensors and data from a multiplicity of heterogeneous discrete strands of material, each naturally sensitive, or specifically made to be sensitive to stressors or the damage caused thereby by coating, cladding, or doping or other means with at least one media substance specific to a class of anticipated stressor or anticipated damage caused by stressors. ~~; and,~~

Please delete paragraph [0088].

Please replace paragraph [0089] with the following amended paragraph:

[0089] In a preferred embodiment, my method is used with at least one electronic processing device of type called a microcontroller, or an interface to another suitable processor with ability to digitize, process, and perform prestored algorithms of calculus and logic, interface with ~~microsensors and~~ the said strands; and

Please replace paragraph [0093] with the following amended paragraph:

[0093] ~~Sensors~~ Discrete sensors in this context are devices that serve a purpose to provide data on environmental, internal, physics, etc. and may be located at a distance communicating by wired or wireless means to the microcontrollers.

Please replace paragraph [0095] with the following amended paragraph:

[0095] In accordance with the present invention the strands of sensitized medium are sensitized so as to provide a means to detect and differentiate causes of damage to a conduit and components thereof or damage occurring in the conduit due to internal factors.

Please replace paragraph [0097] with the following amended paragraph:

[0097] The ~~apparatus~~ method of the present invention provides a means to obtain, store and learn from data; the means to learn and fuse data to probabilistically assess causal factors of damage; the means to

quantify the state of deterioration and damage that has occurred; the means to assess the risk that a situation exists that likely will soon cause deterioration or damage to happen; and the means to formulate and communicate messages about the state of deterioration, damage, risks of damage and causal factors.

Please replace paragraph [0102] with the following amended paragraph:

[0102] In accordance with the present invention, when used in communication with a commercially available computer, the data, causal inferences, probabilities and messages generated by ~~the microcontroller of~~ the present invention can be used ~~by the computer~~ to probabilistically predict future local, system and end effects of faults and failures as well as remedial actions.

Please replace paragraph [0103] with the following amended paragraph:

[0103] The preferred embodiment involves using the method by installing a monitoring apparatus with a computer, microcontroller or other processor for performing algorithms, the apparatus constructed by connecting a battery, power scavenging capacitor, solar cell array, or other suitable source of power, a wireless commercially available microcontroller such as a Sentient.TM. microcontroller, which in turn is connected to a multiplicity of selected commercially available discrete sensors, and a multiplicity of commercially available sensitized strands coated, doped, or clad with specific sensor properties affixed in a largely parallel pattern on a suitable insulating substrate such as a fluoropolymer like EFTE, EFTE-CTFE, FEP, and PFA or mylar or polyimide. The apparatus is either directly attached to a conduit, woven in an insulated mesh, or woven among conductor strands or on an insulating substrate that is subsequently affixed to a conductor or conduit. In service the preferred embodiment is linked by wire or wirelessly to a remote computer such as a commercially available palm, laptop, or desktop model.

Please replace paragraph [0106] with the following amended paragraph:

[0106] The said set of discrete sensors and said multiplicity of strands are selected for each application primarily as a means to provide data about deterioration, damage, or causal factors; and secondarily to provide a means to indicate places where deterioration, damage or threat of damage exists. In a preferred embodiment, all fibers must be nearly of the same diameter, and the strands would be laid out in a measurable pattern that surrounds the conduit such as those shown in the FIG. 1, FIG. 2, FIG. 3, FIG. 5 and FIG. 6. Ideally the pattern strands around the conduit should repeat their pattern in a space of less than one centimeter.

Please add the following new paragraph after paragraph [0106]:

[0106.1] The said multiplicity of strands of sensitized medium, being placed such that damage inducing factors such as an a solid object, gas, liquid, powder or electromagnetic waves contacts said medium prior to contacting said conduit, provide data for determining by a combination of measurement by signal processing and deductive algorithms whether, when and where and to what extent said damage inducing factors have damaged each of said multiplicity of said strands.

Please delete previously added paragraphs [0109a] through and including [0109e].

Please add the following paragraphs after paragraph [0116]:

[0116.1] Referring now to FIG. 7, which shows a flow diagram of steps, in a preferred embodiment), to define, construct, integrate, test and use the method to obtain, store and learn from data; the means to learn and fuse data to probabilistically assess causal factors of damage; the means to quantify the state of deterioration and damage that has occurred; the means to assess the risk that a situation exists that likely will soon cause deterioration or damage to happen; and the means to formulate and communicate messages about the state of deterioration, damage, risks of damage and causal factors. The flow diagram shows a series of steps starting with a procedure to determine requirements [32]; followed by steps that define the diagnostic and prognostic functions [33]; select the characteristics to be sensed and monitored [34], define the appropriate architecture [35]; define a set of discrete sensors and sensitized medium [36]; construct the monitoring devices [37]; develop models [38] that are used during monitoring; develop the monitoring applications [39] until is ready to use. When the monitoring applications are read y to use the flow diagram continues with the steps: install the monitoring apparatus [40]; perform first test sequence [41]; monitoring [42]; diagnosing health states [43]; prognosis [44]; communicating data and knowledge [45]; machine learning [46]; and improving models [47]. In a preferred embodiment, the current method incorporates algorithms that take into account factors such as operating domain and environmental factors that might affect a sensor response. Inference algorithms are those that use prior knowledge of data and/or causal relationships to infer states from data such as from a set of discrete sensors and strands made with sensitized strands. Said strands and said discrete sensors will be individually selected and sited based on the specific parameters they provide in the application and operation environment of the conduit and how damage to one or more sensitized media provides evidence for determining the cause of damage.

[0116.2] Referring now to FIG. 8, which shows a flow diagram for developing the monitoring application [39]. The process steps in FIG. 8 are: conduct first test sequence [41] of discrete sensors and sensitized strands [48] to obtain characteristic data; and conduct first test sequence of the system of conduits [49] to obtain performance, health state metrics, and stressor data in operating and non-operating domains, as well as causal relationships and other data from degraded and failed modes. The data from the first tests being used for developing the algorithms that infer and/or predict health states. The next step is to develop the algorithms [50] which in turn used to develop control software [51] that control the monitoring applications [25]; then integration and testing [52] to perfect the monitoring applications [25]. FIG. 8 includes objects representing the monitoring applications [25]; a compilation of data from first tests [26]; a set of baseline characteristics [27]; a set of causal models [28]; a set of analysis algorithms [29]; and a set of control algorithms [30]. In a preferred embodiment all the models but the conduit models would be Bayesian models because during operation of the monitoring application the models, algorithms and analysis would be Bayesian, because Bayesian calculus inherently has known error bounds which result in known error bounds for the results calculated by the application. In a preferred embodiment the cause and effect (causal) relationship models are Bayesian algorithms that probabilistically take into account possible stressors and the damage they inflict based on data from a set of discrete sensors and a pattern of sensitized media. A person familiar with computing would understand that commercially available software development tools such as MatLab.TM. can be used to develop the algorithms that calculate means, variances, trending, pattern matching, fuzzy logic, distance calculation, truth tables, rules, controls, data fusion, probabilistic inference and other algorithms that comprise the set of analysis algorithms [29] and application development software applications that provide convenient features for integration and testing during development of the monitoring applications.

[0116.3] Referring now to FIG. 9, which shows a flow diagram of the process steps for monitoring [42]. The series of steps shown in FIG. 9 are: initialize for tests [53] and increment the discrete sensor counter [54]; then measure discrete sensor data [55] and determine sensor change [56]. If there is change choose to repeat test [57] to verify the change. If the decision is to not repeat the test then test for if last discrete sensor [58]; if not the last discrete sensor then go to the step increment discrete sensor counter [54] and continue testing discrete sensors until all have been tested. When all discrete sensors have been tested fuse set of discrete sensor data tuples [59]. The next sequence of steps relates to testing for change in the sensitized strands. The process of testing all strands are: increment strand counter [60] then measure sensitized strand data [61] followed by determine strand change [62]. If there is change, choose to repeat strand test [63] to verify the change. If the decision is to repeat the test then repeat the test returning to again measure sensitized strand data [61]. If the decision is not to repeat the test, return to increment

strand counter [60] and continue testing until all sensitized strands have been tested by the decision if last strand [64]. When all sensitized strands have been tested then fuse set of strand data tuples [65] and record the sets of sensor and strand data tuples [66] in the set of data from monitoring [31]. Depending on the sensory element, the signal that elicits the response from the sensitized medium can be of various type such as electricity, light, laser, sound, and high frequency waves. If change or discontinuity of any sensitized media occurs, the spatial location of the damage can be measured by reflectometry, signal strength remaining or other remote means. The distance to the damage can be as short as a few millimeters and at least a few meters. The distance can possibly be as long as several miles for laser signals depending on signal loss in the fiber. The cause of the damage can be interpreted by algorithms that take into account possible stressors and the damage inflicted to the sensitized media.

[0116.4] Referring now to FIG. 10 which shows a flow diagram of the steps for diagnosing health states [43]. The first step is to use data from baseline characteristics [27] and data from monitoring [31] to generate weighting parameters [67] that are used to adjust data for temperature and other environmental effects on the accuracy of data values of data from monitoring [31] with the set of causal models [28] and the set of analysis algorithms [29] used in data fusion [68] used combine evidence to diagnose health states of sensors and strands [69]; to diagnose health states of conduit components [70]; to diagnose health states of conduit sections [71], to diagnose health states of system of conduits [72]; to decide to locate damage [73] and if decision is to locate, then perform a measurement algorithm to locate damage [74]. In either case, follow by a process to record data [85] in the set of data from monitoring [31]. My method uses combining data with data fusion using logic, causal relationships and inference algorithms because, in the case of systems of conduits, some states cannot be observed with a discrete sensor and must be inferred with an inference algorithm based on causal relationships and fusion of data from several discrete sensors and sensitized strands sited near, on, in and along the system of conduits. Data fusion used with logic, as used in truth tables and rules, causal relationships and inference algorithms are means for locating the place of damage and reasoning the probable cause of damage from data. Depending on the sensory element, the signal can be of various type such as electricity, light, laser, sound, and high frequency waves. Damage on a section of conduit is detected, located and its cause inferred when erosion, corrosion, breakage or other factor causes at least one sensitized media to change a response characteristic such as causing the reflection of the signal to be shorter than before with an abbreviated measured distance to the point of discontinuity caused by damage . In the case of ambiguity caused by the branches, data from a discrete sensors, a sensor signal source, or data from sensitized strands located at another branch in the tree provide data for an inference algorithm to locate the place of damage.

[0116.5] Referring now to FIG. 11, which shows a flow diagram showing the steps for prognosis [44] which, on detection of damage, uses algorithms such as trending, pattern matching, fuzzy logic, distance calculation, logic, inference and data fusion predicts future damage states, effects and remedial actions based on impact of damage. The steps shown are: predict damage states [75], predict effects [76] processing characteristics selected from the set of baseline characteristics [27] and data selected from the set of data from monitoring [31] with models from the set of causal models [28], using the results thereof to predict health states [77] using the set of analysis algorithms, and use a Bayesian network or other model to predict remedial actions [78] and then record data [85] in the set of data from monitoring [31]. The current invention uses the causal relationships that were initially determined in first tests and improved with learning over time as a means to predict future local, system and end effects of faults and failures as well as remedial actions.

[0116.6] Referring now to FIG. 12, which shows a flow diagram showing the steps for machine learning [46] to improve the accuracy of the inference algorithms, analytical models and causal models [47]. As shown in FIG. 12, the steps for machine learning are: using data from monitoring [31], baseline characteristics [27], and analysis algorithms [29]; perform inference [79] with Boolean logic or a Bayesian algorithm using data from the set of data from monitoring [31], characteristics from the set of baseline characteristics [27], causal models from the set of causal models [28] and analysis algorithms selected from the set of analysis algorithms [29]. The next step is to compute causal relationships [80] based on the inference and thence update causal models [81] replacing previous causal models in the file causal models [28]; then use parameter estimating algorithms to compute new parameter statistics [82]; and update model parameters [83]. The last step shown in FIG. 12 is to revise the monitoring applications [25] by performing the step of update the monitoring applications [84] with the data from the set of control algorithms [30], baseline characteristics [27], the set of causal models [28] and the set of analysis algorithms [29]. A person familiar with the art of automated learning would realize that machine learning algorithms are widely available in books on artificial intelligence and professional papers on artificial intelligence. The machine learning process acts to improve the models by using machine learning algorithms to compute new parameters, models, relationships and characteristics based on actual values of data from monitoring [31] by using statistical analyses and probabilistic reasoning to improve and update the logic, inference algorithms, causal relationships and other analysis components that improve the monitoring applications. A person familiar with artificial intelligence methods would realize that there are teaching and examples of statistical methods for learning algorithms in numerous publicly available text books and papers on statistical methods on artificial intelligence.

[0116.7] Referring now to FIG. 13 which shows a flow diagram of the steps of diagnosing health states of sensors and strands [69] by using a deductive algorithm, select a-priori information [86] from data sources such as baseline characteristics [27] and the set of causal models [28] (if any) with algorithms selected from the set of analysis algorithms [29]; then process new characteristic information [87] using algorithms selected from the set of analysis algorithms [29] to produce results which are used to determine any changes from prior characteristics based on the recent data from the set of data from monitoring [31] to determine any change from prior characteristics [88] utilizing algorithms selected from the set of analysis algorithms [29]; then record characteristics [89] by placing the results in the set of baseline characteristics [27]; and based on any change make a decision to choose to measure location [90]; if the choice is to measure the location then perform a measurement algorithm to measure the location of the change [91], using either a direct calculation based on the response to the applied signal or apply a measuring technique such as reflectometry on a waveform conducting medium; and using inference or a calculus estimate degree of damage [92] at each point of damage; and record health state information [93] by placing the results in the set of baseline characteristics [27].

Please replace paragraph [0118] with the following amended paragraph:

[0118] ~~Another embodiment would be to place~~ A person familiar with the art of sensoring and using algorithms would know that estimating the speed and depth of damage can be accomplished by an inference algorithm that incorporates spatial parameters of the system of conduits and spatial parameters that describe where the set of discrete sensors and the sensitized strands are located, such as placement of sensitized strands atop one another so that when each in turn is damaged the depth of damage is determined. Cross-talk caused by separated adjacent conduits will not generally be a problem because measurements will usually be performed serially. Non-interfering patterns of discrete sensors and sensitized strands, such as one for voltage and one for light waves, can be laid touching side by side to avoid even a tiny gap that might lead to having an undetected point of damage. Conflicting conducting patterns such as gold and aluminum which both conduct electricity will need spatial clearance or a suitable spacing material to avoid forming junctions, cross-talk or other confounding situations. The pattern of conducting elements can be applied singularly or en masse as an applique embossed on a non-conducting substrate such as polyimide or a fluoropolymer such as EFTE. Or, the pattern of conducting elements can be extruded or embossed directly onto the insulation surface. Whatever the type of pattern helical, coaxial, wavy, etc.) that is used, all distances to a point of damage are also defined.

Please replace paragraph [0119] with the following amended paragraph:

[0119] A person familiar with ~~use of microcontrollers~~ using sensors and sensoring methods for locating sites of damage in a branched tree of conduits would understand that in any embodiment, one or more additional couplings [15] with or without a microcontroller [13] and discrete sensors [19] can be attached to the pattern of sensitized media at locations spaced apart from the first coupling [15], so that differential measurements can be taken at the couplings. The additional information from such measurements at another point of the branches will accurately resolve any ambiguities caused by a plurality of sensitized media in a branched tree of conduits.

Please replace paragraph [0121] with the following amended paragraph:

[0121] While the current invention is described mostly in connection with a presently preferred embodiment thereof, those skilled in the art will recognize that any modifications and changes may be made therein without departing from the true spirit and scope of the invention, which accordingly is intended to be defined solely by the appended claims. For instance, in ~~most figures~~ FIG. 2A, FIG. 3, FIG. 5 and FIG. 6 three distinct sensor elements are shown, but there could be any number arranged in any order. Any person familiar with performing tests for conductivity and reflectometry will concur that any number of sensitized media laid in patterns of any non-interfering arrangement can be utilized.

Please delete paragraph [0125] in it entirety and add the following new paragraph in its place as a new paragraph [0125].

[0125] Generally speaking, the method of the current invention comprises a sequence of steps. A first step is creating the said monitoring apparatus and algorithms to periodically monitor at least a portion of the system of conduits at given points in time over a first extended period and, for each point in time, storing in a digital memory a data couplet containing information concerning the parameters, and the point in time; using digital processors to identify couplets having normal values within a predetermined range; and providing an indication of steady state characteristics if the readings for at least a predetermined number of couples are within a first predetermined range; and providing a programmed diagnostic algorithm for assessing risk of damage and extent of deterioration and damage to the monitored conduits; and providing a prognostic algorithm for estimating the remaining useful life of the monitored conduits and components; and providing a protocol for communicating the information about sensed damage, deterioration, as well as diagnostic and prognostic information concerning the health status and integrity

of the monitored conduits. Then performing a first test sequence on each of the multiplicity of sensitized medium for the purpose of forming a baseline of characteristic parameters of each said medium for future reference by measuring the characteristics and storing the characteristics in accessible storage medium or location for future use. Then, from time to time, performing the same said test sequence on each of the multiplicity sensitized medium; determining if said measured characteristics are substantially equal to previously measured characteristics, the possible outcomes being: a. there is no measurable change to the sensitized portion of the medium b. there is measurable change to the sensitized portion of the medium; c. the medium is disrupted, i.e. broken, eroded, cut through or dissolved; choosing whether to repeat said step of measuring and said step of determining at another point of said medium; if the choice is to repeat, then repeating said steps of measuring and determining. Analyses using deductive algorithms, along with any a priori probability information, is used to: a) process data from said measuring of said set of discrete sensors and said multiplicity of sensitized medium into characteristic information; and b) determine any change of said characteristics from baseline characteristics; and c) record the information for later use; and d) choosing whether to measure the position of the change; if the choice is to measure then measure the location of the change using either direct calculation based on the response to the applied signal; or apply a measuring technique such as reflectometry on a waveform conducting medium; and record the measured value and temporal information if available; and using a calculus estimate the degree of damage for each said sensitized media at each recorded point of damage, for each time if temporal information is recorded.

Please replace paragraph [0126] with the following amended paragraph:

[0126] ~~The sensor medium should be in contact with the surface of the conduit. If a heat shrinkable substrate is used, the embodiment is heated appropriately to tightly affix the embodiment to the segments of the interconnection assembly.~~ In operation the <u>set of discrete sensors and strands of</u> sensitized media encasing the segments will be affected by stressors operating on them. End-to-end tests or <u>single ended</u> tests such as <u>measuring light or</u> reflectometry can be used to detect damage to any sensitized media able to carry the waveforms. On detection of said damage ~~the computer~~ <u>my method</u> uses algorithms such as trending, pattern matching, fuzzy logic, distance calculation, logic, inference and data fusion to determine the type, location and cause of the damage as well predict future impacts of the damage if damage is allowed to progress into the protective insulation and eventually the conducting core. Next, the results of the detection, location, and determination of cause are used to initiate or request actions that mitigate or remove the stressor or stressors that are the cause of damage as well as corrective actions to bypass, repair or otherwise deal with the damage. During said actions the damage to the interconnection system is

repaired and damaged and sections of the sensitized media used in the embodiment of the invention are replaced or repaired.

Please add following new paragraphs after paragraph [0126] effectively moving the original claims into the specification:

[0126.1] The method of the current invention involves a diagnostic and prognostic system for monitoring the health status and integrity of conduits, the system comprising: a plurality of local health status and integrity monitoring devices each capable of inspecting the health status of local individual conduits and conduit components, each local monitoring device having: a centralized data processor coupled to the plurality of local monitoring devices, the centralized data processor for receiving from each local monitoring device the local data concerning its associated conduits, for generating a set of weighting parameters for each local conduit monitoring device, and for communicating the set of weighting parameters to each local conduit monitoring device; and a local data processor of each local monitoring device further for receiving the set of weighting parameters, collecting data regarding the local conduit and analyzing the local data using the set of weighting parameters for local diagnostic and prognostic purposes.

[0126.2] The method of the current invention is used in conjunction with a monitoring device for use in monitoring at least one conduit with at least one conductor for diagnostic purposes, the device comprising: at least one programmed microcontroller or other processor for the purpose of acquiring the sensor information from a set of sensors and sensitized medium, conditioning and normalizing the sensor information based on parameters and environmental condition of the conduit, and for processing the normalized information to provide an output signal indicative of the diagnostic condition and the prognostic estimate of remaining useful life of the conduit and conductors it monitors. a set of sensors having outputs coupled to the programmed processor, at least one sensor being an environmental sensor for providing environmental information indicative of the local environmental condition, and sensors that are strips or strands of heterogeneous sensitized medium said medium either essentially opaque to signal transmission, or selected from the group of mediums that are capable of supporting or conducting an electrical current and voltage, an electromagnetic signal, an optical signal, an audio signal, and an indicating substance with the purpose to provide sensor information indicative of damage to the sensitized medium; with each sensor or strand of sensitized medium being positioned with respect to the conduit to provide information concerning the environment and damage and deterioration to the conduit; and means operatively associated with the programmed processor for operating the processor in a birth certificate

mode wherein the outputs of the sensors are processed by the programmed processor and stored in as baseline operational parameters; and means associated with the programmed processor for operating the device in a monitoring mode, after the program has operated in the birth certificate mode, wherein the programmed processor acquires, conditions, and processes the outputs from the sensors, compares the processed outputs to the baseline operating parameters, and provides an indication of the diagnostic condition of the conduit based on the comparisons.

[0126.3] The current invention is a method for diagnosis and prognosis of the health status of conduits, comprising the steps of: determining the requirements for monitoring the system of conduits; defining the functions of diagnostic and prognostic method to meet the requirements; defining the parameters to be sensed and monitored; designing an apparatus with parameter generating components consisting of an assortment of electronics, hardware, software, firmware, a set of discrete sensors, and strands of sensitized medium.

[0126.4] The parameters processed in the algorithms are measurements from a set of discrete sensors and sensors that are strands made up of diverse sensitized media including hollow, filled or solid strands, fibers and strips made with combinations of inorganic, organic or man-made materials. The discrete sensors and sensitized strands are positioned with respect to the conduit to provide information concerning the environment and real or potential damage and deterioration to the conduit; and the sensors produce an optical phenomena when stimulated.

[0126.5] The method of the current invention logically and mathematically combines the environmental and the baseline operational parameters. The results of processing the parameters are indicative of any stress or any damage to the sensitized medium by comparing the processed outputs to the baseline operating parameters, and provides an indication of the diagnostic condition of the conduit based on the comparisons.

[0126.6] The method of the current invention operates as a distributed diagnostic and prognostic method for monitoring the health status and integrity of system of conduits, with data processed by a plurality of local health status and integrity monitoring devices each capable of inspecting the health status of local individual conduits and conduit components, each local monitoring device having: a data processor coupled to the plurality of local monitoring devices, the data processor for receiving from each local monitoring device the local data concerning its associated conduits, for generating a set of weighting parameters for each local conduit monitoring device, and for communicating the set of weighting

parameters to each local conduit monitoring device; and a local data processor of each local monitoring device further for receiving the set of weighting parameters, collecting data regarding the local conduit and analyzing the local data using the set of weighting parameters for local diagnostic and prognostic purposes.

[0126.7] A preferred embodiment would include a monitoring device for use in monitoring at least one conduit with at least one conductor for diagnostic purposes, the device comprising: at least one programmed microcontroller or other processor for the purpose of acquiring the sensor information from a set of sensors and sensitized medium, conditioning and normalizing the sensor information based on parameters and environmental condition of the conduit, and for processing the normalized information to provide an output signal indicative of the diagnostic condition and the prognostic estimate of remaining useful life of the conduit and conductors it monitors.

[0126.8] A preferred embodiment would include a set of sensors having outputs coupled to the programmed processor, at least one sensor being an environmental sensor for providing environmental information indicative of the local environmental condition, and sensors that are strips or strands of heterogeneous sensitized medium said medium either essentially opaque to signal transmission, or selected from the group of mediums that are capable of supporting or conducting an electrical current and voltage, an electromagnetic signal, an optical signal, an audio signal, and an indicating substance with the purpose to provide sensor information indicative of damage to the sensitized medium; with each sensor or strand of sensitized medium being positioned with respect to the conduit to provide information concerning the environment and damage and deterioration to the conduit; and means operatively associated with the programmed processor for operating the processor in a birth certificate mode wherein the outputs of the sensors are processed by the programmed processor and stored in as baseline operational parameters; and means associated with the programmed processor for operating the device in a monitoring mode, after the program has operated in the birth certificate mode, wherein the programmed processor acquires, conditions, and processes the outputs from the sensors, compares the processed outputs to the baseline operating parameters, and provides an indication of the diagnostic condition of the conduit based on the comparisons.

[0126.9] In a preferred embodiment the sensor set includes at least one temperature sensor. The monitoring device would reference baseline operational parameters that include the said temperature sensor: (i) means; (ii) variances; (iii) range; (iv) and the overall temperature spectrum characteristics of the conduit.

[0126.10] In a preferred embodiment the sensor set includes at least one vibration sensor and the baseline operational parameters include the said vibration sensor: (i) means; (ii) variances; (iii) range; (iv) and the overall vibration spectrum characteristics of the conduit.

[0126.11] In a preferred embodiment the sensor set includes at least one conduit electromagnetic interference (EMI) sensor and the baseline operational parameters include the said EMI sensor: (i) means; (ii) variances; (iii) range; (iv) and the overall spectrum of EMI characteristics of the conduit.

[0126.12] In a preferred embodiment the sensor set includes at least one strand of temperature sensitized medium and the baseline operational parameters include the said strand of temperature sensitized medium: (i) means; (ii) variances; (iii) range; (iv) and the overall characteristics of the strand.

[0126.13] In a preferred embodiment the sensor set includes at least one strand of corrosivity sensitized medium and the baseline operational parameters include the said strand of corrosivity sensitized medium: (i) means; (ii) variances; (iii) range; (iv) and the overall spectrum of corrosivity characteristics of the strand.

[0126.14] In a preferred embodiment the sensor set includes at least one strand of chafing sensitized medium and the baseline operational parameters include the said strand of chafing sensitized medium: (i) means; (ii) variances; (iii) range; (iv) and the overall characteristics of the strand.

[0126.15] In a preferred embodiment the sensor set includes at least one strand of pressure sensitized medium and the baseline operational parameters include the said strand of pressure sensitized medium: (i) means; (ii) variances; (iii) range; (iv) and the overall characteristics of the strand.

[0126.16] In a preferred embodiment the sensor set includes at least one strand of chemically sensitized medium and the baseline operational parameters include the said strand of chemically sensitized medium: (i) means; (ii) variances; (iii) range; (iv) and the overall characteristics of the strand.

[0126.17] In a preferred embodiment the sensor set includes at least one strand of piezoelectric sensitized medium and the baseline operational parameters include the said strand of piezoelectric sensitized medium: (i) means; (ii) variances; (iii) range; (iv) and the overall characteristics of the strand.

[0126.18] In a preferred embodiment the sensor set includes at least one strand of base metal coated medium and the baseline operational parameters include the said strand of base metal coated medium: (i) means; (ii) variances; (iii) range; (iv) and the overall characteristics of the strand.

[0126.19] In a preferred embodiment the sensor set includes at least one strand of noble metal coated medium and the baseline operational parameters include the said strand of noble metal coated medium: (i) means; (ii) variances; (iii) range; (iv) and the overall characteristics of the strand.

[0126.20] In a preferred embodiment the sensor set includes at least one strand of clad silica sensitized medium and the baseline operational parameters include the said strand of clad silica medium: (i) means; (ii) variances; (iii) range; (iv) and the overall characteristics of the strand.

[0126.21] In a preferred embodiment the sensor set includes at least one strand of fluorescent doped sensitized medium and the baseline operational parameters include the said strand of fluorescent doped sensitized medium: (i) means; (ii) variances; (iii) range; (iv) and the overall characteristics of the strand.

[0126.22] In a preferred embodiment monitoring device would further comprise a visual indicator coupled to the processor for receiving the output signal generated by the algorithms running in the processor, and for providing a visual indication of the diagnostic condition of the conduit based on the output signal.

[0126.23] In a preferred embodiment the sensitized media provides a means for coupling to a plurality of conductors and connectors at spaced apart locations along the branches; and a terminator connected to a first connector; and, a means to attach appropriate signals including, but not limited to, direct current or alternating current electricity, radio waves, audio signals, and beams of light; and a means to attach a signal analysis instrument.

[0126.24] In a preferred embodiment the sensitized media, the signal generators with the signal detectors, and the microcontroller or other computer comprise a means to quantitatively measure changes in signals and secondary effects as a means to detect the presence, degree, and location of deterioration or damage to the insulation material.

[0126.25] In a preferred embodiment the sensitized media is made up of diverse sensitized media including hollow, filled or solid strands, fibers and strips made with combinations of inorganic, organic or man-made materials.

[0126.26] In a preferred embodiment at least one of the sensitized media comprises a mixture of dielectrics.

[0126.27] In a preferred embodiment at least one of the sensitized media which provide data for my method is in coaxial relationship to the insulated cores with linear, curvilinear, or helical format.

[0126.28] In an preferred embodiment at least one of the sensitized media that provide data for my method is fabricated on an inner layer of the insulation.

[0126.29] In an preferred embodiment at least one of sensitized media is fabricated on the outer surface of the insulation.

[0126.30] During selecting the preferred set of discrete sensors and strands of sensitized medium that provide data for my method perform a first test sequence on each of the set of discrete sensors and each of the strands of sensitized medium for the purpose of forming a baseline of characteristic parameters of each said discrete sensor and each said strand of sensitized medium for future reference by measuring the characteristics and storing the characteristics in accessible storage medium or location for future use. Analysis of the data of first tests is used to develop a set of baseline operational parameters that include: (i) means; (ii) variances; (iii) range; (iv) and the overall spectrum characteristics of the operational characteristics of the conduits and system of conduits, the set of discrete sensors and the strands of sensitized medium. Analyzing the said baseline of characteristic parameters provides a means to select those discrete sensors and strands of sensitized medium most appropriate for the intended purpose.

[0126.31] During developing the monitoring application, the developer should perform of a series of first tests with the system of conduits in operational, degraded, and non-operational modes. The first tests would include operation in a range of health states using real or simulated conditions to collect data and measure performance in the presence of causal factors and damage as a means to develop the software monitoring application with diagnostic and prognostic capabilities. The operational characteristics, in turn, are used to develop logic and statistically accurate probabilistic (Bayesian) models of health states of the system of conduits.

[0126.32] The purpose of measuring the characteristics of the system of conduits operating in degraded or faulty states over a period of time is to provide characteristics for developing sufficiently accurate algorithms and models that infer and recognize causal relationships as well as diagnose conditions leading to unhealthy states, diagnose the health state, and predict future health states as a function of time. by measuring the characteristics of degraded states over time. For example, if Bayesian statistical processing of data from a number of tuples at a point in time shows values within a predetermined range they provide an indication of a healthy state, but if processing of the same number of tuples shows values at a point in time are outside a predetermined range they indicate an unhealthy state. The said logic and (Bayesian) inference algorithms provide a baseline for assessing risk of damage and extent of deterioration and damage to the monitored conduits at a point in time; to provide a statistically accurate prognostic algorithm for estimating the remaining useful life of the monitored conduits and components and incorporate machine learning algorithms that work to continuously improve the modeling application.

[0126.33] It is to be noted that a person familiar with the art of sensoring would know that Bayesian mathematics, inference algorithms, and software programs are described in detail in numerous widely available text books and publications and articles. Further, said person would agree that Bayesian methods are widely used, and that Bayesian mathematics are statistically accurate with the inherent ability to measure the amount of statistical error in each calculated result.

[0126.34] The data would be collected at predetermined points in time and for each point in time, storing tuples containing information concerning the parameters and the point in time the data was collected. During development the person developing the monitoring application would perform analyses of the tuples, using the results of analysis to develop the logic, inference algorithms and models that in combination form the diagnostic and prognostic functions of the at least one monitoring application.

[0126.35] Once sufficiently developed and tested the monitoring device together with the at least one monitoring application would be installed by applying, placing, attaching or embedding the monitoring device, the set of discrete and a multiplicity of strands of said sensitized medium along the length of a system of conduits, wherein said strands of sensitized medium has a first end and a second end, said strands of sensitized medium being placed such that damage inducing factors such as a solid object, gas, liquid, powder or electromagnectic waves contact strands of said sensitized medium prior to contacting a conduit.

[0126.36] A next step in my method is verification and validation of the at least one monitoring application accomplished by performing a first test sequence on each of the multiplicity of the sensitized medium for the purpose of forming a baseline of characteristic parameters each sensitized medium for future reference by measuring the-characteristic parameters and storing characteristic parameters in accessible storage medium or location for future use. The process of verification and validation is performed for each operating domain of the system of conduits by periodically monitoring at least a portion of the system of conduits at given points in time over a first extended period and, for each point in time, storing in a digital memory a data couplet containing information concerning said parameters, and point in time; and forming tuplets that represent the time of the sample, identity of the sensor, and said parameter values. During monitoring my method uses programmed algorithms to identify tuplets having normal values within a predetermined range; and providing an indication of steady state characteristics if said parameter values for at least a predetermined number of tuples are within a first predetermined range. During the verification and validation process, in a preferred embodiment, the method is tested in a manner introducing stresses and damage providing tests of the programmed diagnostic algorithms for assessing risk of damage and extent of deterioration and damage to the monitored conduits. In a preferred embodiment, as damage is detected during monitoring, the process of verification and validation tests the predictive algorithms for estimating remaining useful life of the monitored conduits and components and tests the protocol for communicating information about sensed damage, deterioration, and as well as diagnostic and prognostic information concerning the health status and_integrity of the monitored conduits.

[0126.37] After installation of the monitoring device from time to time perform the same said first test sequence on each discrete sensor and on each of the multiplicity sensitized medium for the purpose of determining if said measured characteristics are substantially equal to previously measured characteristics. The possible outcomes being: a. there is no measurable change to the characteristics; b. there is measurable change to the characteristics; c. the characteristics indicate the discrete sensor or sensitized medium under test is disrupted, i.e. broken, eroded, cut through or dissolved; choosing whether to repeat said step of measuring and said step of determining perhaps at another point of said medium; if the choice is to repeat, then repeating said steps of measuring and determining; using a deductive algorithm along with any a priori probability information to: a) process data from said measuring into characteristic information; and b) determine any change of said characteristics from baseline characteristics; and c) record the information for later use; and d) choosing whether to measure the location of the change; if the choice is to measure then measure the location of the change using either direct calculation based on the response to the applied signal; or apply a measuring technique such as

reflectometry on a waveform conducting medium; and record the measured value and temporal information if available; and using a calculus estimate the degree of damage for each said sensitized media at each recorded point of damage, for each time if temporal information is recorded.

[0126.38] Once the monitoring application has been developed, verified, and validated, the next step is integration, testing, and operational use with one or more system of conduits. In operational use, the monitoring application processes the data from monitoring with logic and algorithms to sense damage, locate damage, perform diagnostics and prognostics of the health state of the set of discrete sensors, the health state of the set of sensitized strands, and the health state of the system of conduits.

[0126.39] In a preferred embodiment of my method, there would be a protocol for communicating the information about sensed damage, deterioration, as well as diagnostic and prognostic information concerning the health status and integrity of the monitored conduits.

[0126.40] Once the said apparatus and the monitoring application are sufficiently developed, the ability to meet requirements should be validated by testing under realistic conditions.

Please replace paragraph [0132] with the following amended paragraph:

[0132] The information in this patent disclosure discloses the idea, embodiment, operation of the invention in order to support the stated claims. The scope of the claims ~~include~~ includes variants of the use of inference algorithms, logic and other mathematical and statistical methods in conjunction with processors processing data from a set of discrete sensors and patterns of diverse and different sensitized media formed, laminated, extruded, glued, taped, on or in materials such as insulation and materials used to construct various types of conduits. ~~The types of sensitized media include, but are not limited to, piezoelectric strands, coated and uncoated strands of electrically conductive materials, coated or uncoated strands of optically conductive materials, soluble conductive strands, strands of or coated with base and noble metals, and materials used in waveguides and transmission lines.~~ The various types of conduits include, but are not limited to, harnesses and cables of electrical and fiber optic systems as well as conduits comprised of pipes and hoses carrying liquids, gases and solids.

Please delete paragraphs [0133] and [0134].

Please replace paragraph [0135] with the following amended paragraph:

[0135] A person familiar in sensoring would appreciate and understand that the discrete sensors and the strands of sensitized medium may not be necessary in some alternate embodiments.

Please add the following two new paragraphs after paragraph [0136]:

[0136.1] A person familiar in developing algorithms for sensoring would appreciate and understand that some steps shown in FIG. 7 through FIG. 13 may not be necessary in some alternate embodiments.

[0136.2] A person familiar in the art of developing computer programs would appreciate that the algorithms can be substituted freely with equivalent components to adapt to specific application requirements.

Please replace paragraph [0143] with the following amended paragraph:

[0143] A person familiar in the art of sensors would understand that if an electrically conductive sensitized media was used as a sensor, a load resistor or capacitor to a segment of the applique conduit for performing measurements to determine and localize a discontinuity or change in impedance between the two connectors. The couplings [15] could self contain a multiplicity of miniature lasers such as a vertical cavity semiconductor lasers and detection by a light detector perhaps implemented with a directional coupler along with a microcomputer. Similar configurations would use radio frequencies, microwaves, or spectral energy with appropriate detectors.

Please replace paragraph [0146] with the following amended paragraph:

[0146] A person familiar in signal measurement would agree that while it is possible to make measurements on a terminated and active insulated conduit, it is also possible to make measurements on an un-terminated insulated conduit. Said person would also understand that no signal is added or taken from the conduit, which is insulated. However, the accuracy of measurement is greatest when the distance between the measuring instrument (e.g. a reflectometer) is small and the terminating impedance is lowest. It will also be understood measurements can be made over more than one segment of a conduit with reduced accuracy. This is consistent with the use of reflectometry in testing of multiple segments of conduits in long distance communication systems and long distance electrical lines.